

# Integration of Autonomous UxS into USN Experiments

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## Report Documentation Page

*Form Approved*  
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>AUG 2011</b>	2. REPORT TYPE	3. DATES COVERED <b>00-00-2011 to 00-00-2011</b>		
4. TITLE AND SUBTITLE <b>Integration of Autonomous UxS into USN Experiments</b>			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>SPAWAR Systems Center Pacific, 53560 Hull St, San Diego, CA, 92152</b>			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>				
13. SUPPLEMENTARY NOTES <b>AUVSI Unmanned Systems North America, Washington, DC, August 16-19, 2011</b>				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>		
		18. NUMBER OF PAGES <b>14</b>	19a. NAME OF RESPONSIBLE PERSON	



# Demand Signal

- SECDEF Guidance for the Development of the Force
  - Ensure sea-based mid-range UAS in two locations in FY12, including sea-based ISR for the National Mission Force
  - NLT FY15, conduct CVN-based experiments with N-UCAS
  - Assess the feasibility of accelerating IOC of CVN-based unmanned aircraft for strike and ISR
- SECNAV Priorities
  - Sailors, Marines, Families
  - Procurement & Industrial Base
  - Unmanned Vehicles
  - Energy
- CNO Direction
  - **Move Boldly:**
    - With fiscally achievable solutions
    - From Platform-Centric to Information-Centric structures and processes
    - Into Unmanned, machine Autonomous technologies
    - Creating a Fully-Integrated Intel, C2, Cyber & Networks Capability
    - Improve sea-based mid-range unmanned ISR capability



**We must think differently about how we acquire and integrate UxS.**



# Naval Pioneers

- “**Air Admiral**” **RADM William A. Moffett** lobbied successfully for acceptance of aviation within the Navy, detailing the need for a central authority to coordinate affairs. In 1919, as a result of his certainty that aircraft carriers would be the best weapon system to have if the US had to go to war in the Pacific with Japan, catapults and planes were fitted to battleships and flying boats were added to ships, laying the foundations for the aviation-dominated Navy that would emerge and change the course of World War II.
- As director of the Naval Reactors Branch, **Admiral Hyman G. Rickover** developed the world's first nuclear powered submarine, USS Nautilus (SSN 571). In the years that followed, Admiral Rickover directed all aspects of building and operating the nuclear fleet that changed the world.
- **UxS effort requires similar approach to previous Naval Innovations and is expected to change the course of Naval Warfare**

**Core Group required to shepherd this new & disruptive technology**



# Challenges of the Naval Mission

- Naval Unmanned Systems must operate in all four domains – Air, Ground, Sea-surface and Sub-surface
- Maritime environment presents different challenges
  - Months and weeks vs days and hours on station time
  - Stealthy and undetected
  - Vastness of the open ocean
  - High number of “white” contacts in choke points
  - Difficulties of sensor and C2 operations
- Naval UxS must work independently and teamed with other manned and unmanned platforms
  - Collaborative networks
  - Netted, meshed teams
- Higher levels of autonomy must be defined and supported by technology development
  - Manpower challenges
  - When does the UxS “call home”?
  - Experimentation will be a key component to building the trust needed for autonomous systems

**Develop venues that bring together technology providers and warfighters to help develop new warfighting concepts, training standards, doctrine and TTPs.**

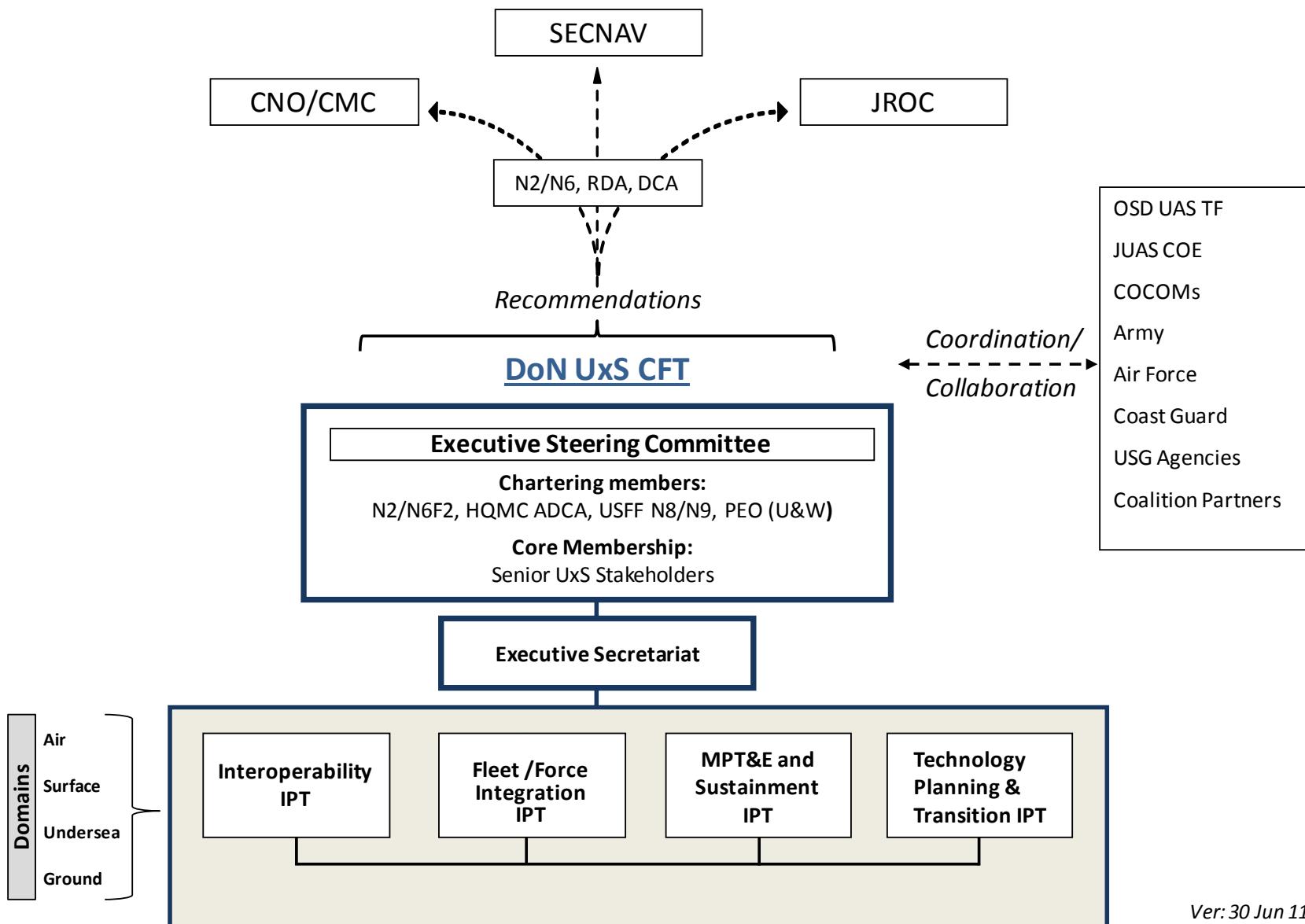


# Unmanned Systems Cross Functional Team (UxS CFT)

- Naval Forces require a coordinated approach to UxS development for:
  - Requirement Priorities
  - Investment strategies
  - Interoperability
  - Fleet introduction
  - Manpower
  - Technology Transition
- Jul '09 – ASN RDA designates PEO(U&W) the “Unmanned Systems Focal Point”
  - Early vision of UxS CFT approach developed
- Apr '10 - “Naval UxS CFT” MOA signed –
  - OPNAV N2/N6, PEO(U&W) and USFF N8/N9 agreement to charter a Naval UxS CFT
  - HQMC ADCA included as Executive Steering Committee Member
- Nov '10 - Naval UxS CFT charter signed
- Utilize Mission Engineering as one of several CFT tools to provide context, rigor and repeatability in cross-domain Mission Thread Analysis and solutions development among the IPTs and WGs



# The UxS CFT Organization





# CFT UxS CFT Mission Statement

- Assess barriers and issues associated with the development, integration and fielding of UxS capabilities in order to implement or facilitate effective solutions
- Guided by service vision and goals, the UxS CFT will coordinate resolution of identified barriers and issues across all stakeholder organizations
- Proactively drive and/or influence decisions to ensure the efficient fielding of unmanned systems with enhanced joint capability while optimizing resource efficiency

**Through cooperative participation by contributing organizations and senior leadership support the CFT will effect the desired changes necessary to develop, field and integrate UxS capabilities**



# ME Across Domains

## UxS Capability Contributions Roll up of CFT IPT Tasks

Capability n

- FFI IPT Efforts
  - Weaponized Fire Scout CONOPS
  - Sea Based Perimeter/HVA Defense NLW Experimentation
- Interoperability IPT
  - Full Motion Video from Fire Scout backhaul from LCS
  - Common Controller
  - TCPED Integration
- TP&T IPT
  - Autonomy - Automatic Target Recognition Capability Gap
  - Autonomy - Platform and Sensor Autonomy Capability Gap
- MPT&E IPT
  - Current Training Assessment
  - Training Commonality Investigation

... that provide options to developing Interoperable and Integrated capabilities across domains in multiple Naval Missions

CFT Stakeholders working ME and discreet DOTMLPF, P tasks that constitute important components of Naval Capabilities . . .

## Multi - Mission Capabilities

Missions provide operational needs, requirements, and environment documented in doctrine, TTPs, SOPs, etc.



### Capability

- System-of-Systems solution
- Satisfies requirements in one or more mission areas

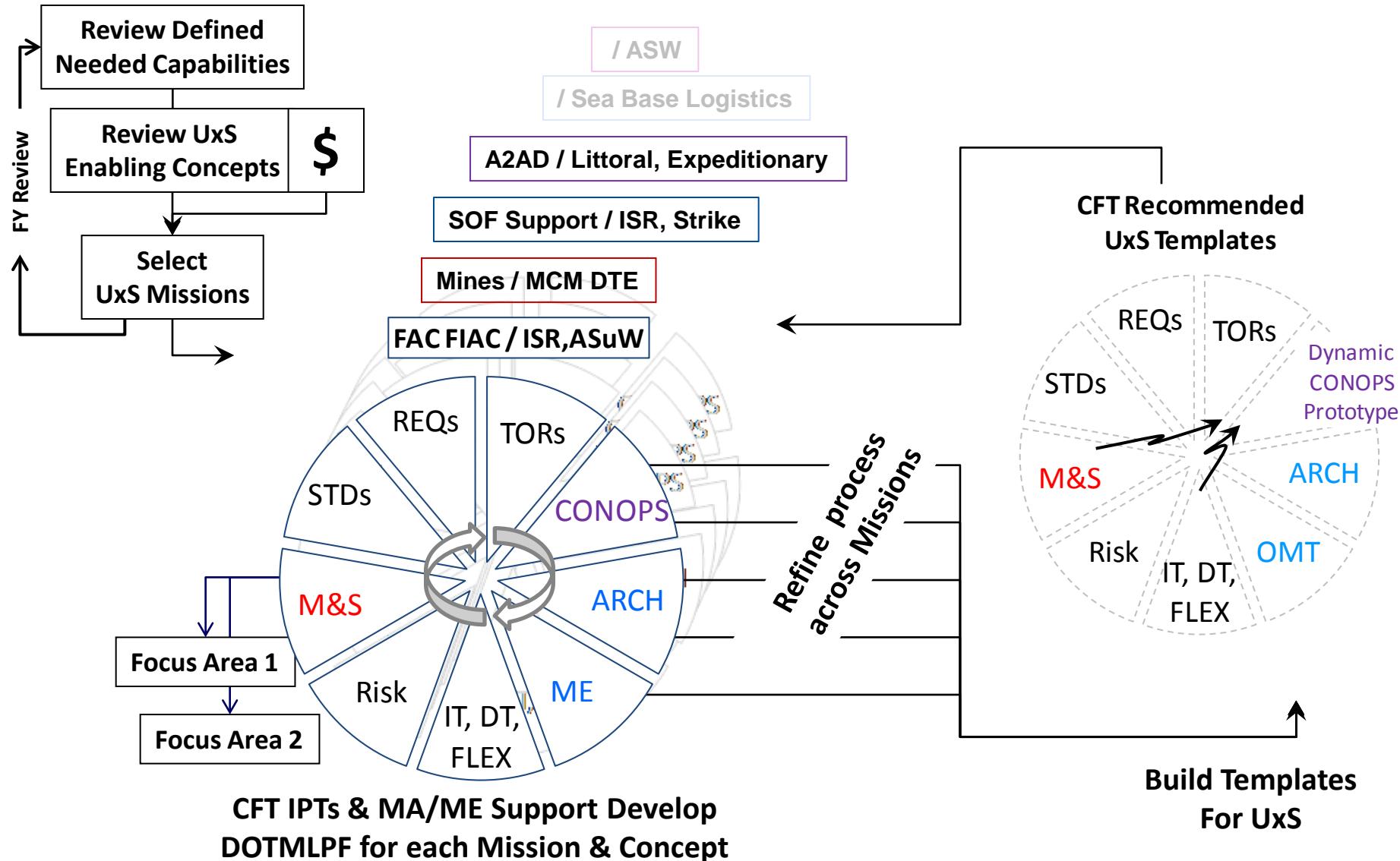


- Focusing on Capabilities makes workload achievable, specific to UxS
- We will tie into existing USN missions as needed to help define efforts

**Operational, Requirements/Resources, S&T, Warfare Centers and Acquisition Stakeholders Rigorous Collaboration**



# FLEX CFT Campaign Plan Process





# Autonomy and Automation

- CFT's approach:
  - Develop methodologies for analyzing & prioritizing automation opportunities
  - Explore opportunities for near-term automation gains
  - Identify trends that span multiple operating domain
- UxS Experimentation will be used to produce “CONOPS-like” documents for automated and autonomous systems
- Manpower Requirements
  - Vehicle Operators – 1 with many
  - Sensor operators – 1 with many, of various types, fused info
  - Analysts – be “On the Loop” vs “In the Loop” for decision making
  - Maintenance – self-monitoring and self-healing
- Training Requirements
  - Trust in the performance of the vehicle must be learned by the human
  - Human must be the decision maker and understand the information and recommendations presented
  - Can systems learn and adapt and can that behavior be integrated into the TCPED?
- Current “Levels of Autonomy” definitions lack the fidelity needed to assess a robot's autonomy/automation in the maritime environment



# FLEX Autonomy Goals

- Priorities for technology development
  - Autonomous vehicle operations / Common Control System
  - Remote sensing
  - Vehicle power
  - C2 requirements (meshed networks)
- Develop warfighters confidence in the abilities of the system.
- Determine what is affordable and how costs can be measured relative to other systems.
- Address some key issues:
  - Can a machine (computer) make better decisions than a human?
  - Who is accountable for these actions?
  - What are the moral and ethical implications?
- Identify the implications of autonomous UxS technology to the rules of engagement.

**Exploring opportunities for modeling and simulation to provide more rapid and cost-effective CONOPS development**



# Conclusions

- Naval Maritime Missions present unique challenges – addressing these challenges requires a robust and integrated experimentation venue.
- The Naval UxS CFT was established to focus on delivering products that will address unmanned challenges, barriers, issues, opportunities, etc.
- Mission Engineering is one of several CFT tools to provide context, rigor and repeatability in cross-domain Mission Thread Analysis and solutions development.
- Increased autonomous capabilities for UxS include more complex tasks and operations with associated growth in mission capabilities, operational flexibility and adaptability.
  - Each of these characteristics may have a significant impact on related human workload.
  - Future missions will demand much greater levels of autonomous behaviors as part of an integrated manned - unmanned team.
  - Continuous human intervention is fundamentally inconsistent with the basic objective required for persistent operations across the operational areas for naval forces.
- Defined Levels of Autonomy will ensure mission threads across the maritime environment can be adequately addressed through experimentation and exercises in a consistent manner.

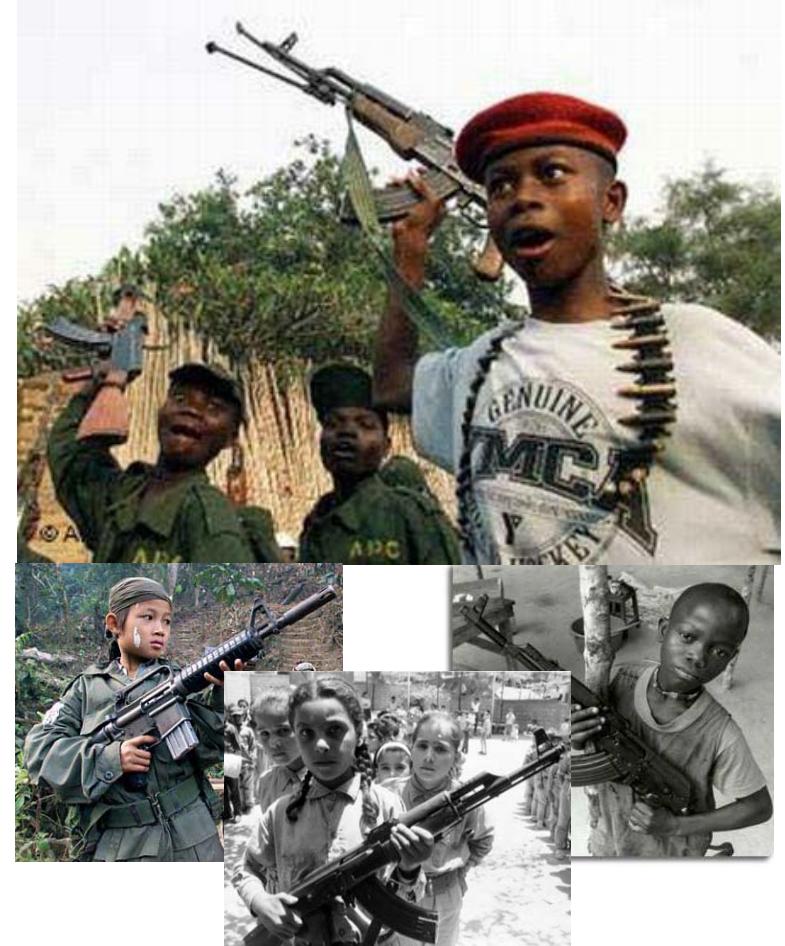


# Final Thought on Autonomy

## Our Standard



## Other Standards



What are the autonomy analogs to grammar school, middle school, high school and basic training?

# Questions

